REMARKS

This Amendment is being filed in response to the April 27, 2009 Office Action. No new matter is introduced by this amendment. The amendment to claim 3 is supported by the present specification, including paragraphs [0084], [0102], and [0118] of the published application. New claim 6 is supported by the published application at paragraphs [0035] to [0037] and [0045] to [0048]. The published application at paragraph [0047] provides support for new claim 7. Support for new claim 8 is found in the published application at paragraph [0048]. For the following reasons this application should be allowed and the case passed to issue.

Claims 3 and 6-8 are pending in this application. Claims 3-5 were rejected. Claim 3 has been amended in this response. Claims 4 and 5 are canceled in this response. Claims 1 and 2 were previously canceled. Claims 6-8 are added in this response.

Claim Rejections Under 35 U.S.C. § 103

Claims 3-5 were rejected under 35 U.S.C. § 103(a) as being unpatentable over Erdman (US 5,225,712) in view of Clarke et al. (WO 03/017407) and Oga et al. (JP 2000-073932). This rejection is traversed, and reconsideration and withdrawal thereof respectfully requested. The following is a comparison between the present invention, as claimed, and the cited prior art.

An aspect of the invention, per claim 3, is a method of designing a redox flow battery system comprising the steps of determining a difference between an output of power generation of generating equipment that varies irregularly in output of power generation, and a desired target output obtained by smoothing the output of power generation and determining an average value and a standard deviation of a distribution of the output difference. At least one of a specified output of the redox flow battery, number of the batteries, a specified output of a DC/AC converter for converting the battery output, and number of the DC/AC converters for

converting the battery output, to maximize a system efficiency of the system or to minimize a loss rate of the system, based on the average value and the standard deviation is determined.

The Office Action asserted that Erdman discloses a method of designing a battery system but is silent as to the energy storage device being a redox flow battery, or the use of a standard deviation to determine capacity of the battery, the number of batteries, or output power to the power grid from the energy storage device, which is power outputted from the inverters. The Office Action relied on Clarke et al. for teaching a rechargeable cerium zinc oxide redox flow and relied on the teaching of Oga et al. of determining an average value of variables in a wind power generator and battery system.

Erdman, Clarke et al., and Oga et al., whether taken in combination, or taken alone, do not suggest the claimed method of designing a redox flow battery because Erdman, Clarke et al., and Oga et al. do not suggest the steps of determining a difference between an output of power generation of generating equipment that varies irregularly in output of power generation, and a desired target output obtained by smoothing the output of power generation, determining an average value and a standard deviation of a distribution of the output difference, and determining at least one of a specified output of the redox flow battery, the number of batteries, specified output of the DC/AC converter for converting the battery output, and number of the DC/AC converters for converting the battery output, to maximize efficiency of the system or to minimize a loss rate of the system, based on the average value and the standard deviation, as required by claim 3.

The Office Action asserted that Erdman discloses a method of designing a battery system. However, Erdman teaches improving a power factor by detecting a phase of reactive power with a wind turbine power converter and discloses a technique that smoothes the output of a variable

speed wind turbine. Particularly, Erdman discloses a structure in which three-phase AC output of the wind turbine is rectified, converted to a fixed output with an inverter, and then supplied to a grid (Fig. 1 and Fig. 2). The structure has energy storage devices (25, 27) connected to active rectifiers (20, 22), and the examples of the storage devices include lead-acid batteries. Fig. 17 shows that a shortage with respect to a constant average output power is compensated by the energy storage devices such as lead-acid batteries, and that an output exceeding the constant average output is charged to the energy device (col. 10, line 53 to col. 11, line 18). Thus, Erdman does not disclose a method of designing a redox flow battery to determine how great the magnitude of the redox flow battery should be for a combination with wind power generation, rather Erdman discloses a method of operating a wind power generation (the wind turbine) that is combined with batteries.

Regarding the magnitude of the energy storage device to be combined with the wind power generation, Erdman teaches, "[i]f cost, size, and maintenance of electrical energy storage devices were not factors, then a large energy storage would be advantageous for most uses. However, in any project cost, size, and maintenance are common concerns." Erdman mentions a degree at which energy storage devices can cope with charging/discharging 200-300 KW for short periods of time such as 10-15 minutes without providing any particular reason.

In view of the teaching of Fig. 17 of Erdman, it is clear that Erdman only compensates the excess and shortage with respect to the constant average output power with the output of the wind power generation and charging/discharging of the energy storage devices and Erdman does not remotely suggest a means of determining the magnitude of the energy storage device combined with wind power generation in view of an arbitrary target output pattern.

The Office Action relied on Fig. 18 of Erdman as teaching the case where a fuel cell is used as the energy storage device. When a fuel cell, which cannot be charged, is used as the energy storage device, the output exceeding the constant average output power is directly supplied to the grid, while the shortage is compensated by the fuel cell (col. 11, lines 19-43). Therefore, Fig. 18 does not appear to be relevant to the present invention.

Clarke et al. do not cure the deficiencies of Erdman. Clarke et al. disclose load leveling batteries that employ a redox flow battery in which an electrolyte includes a cerium-zinc redox pair, and the reduction of cerium and oxidation of zinc produce current provided by the battery. In other words, the technique disclosed in Clarke et al. indicate that a redox flow battery is effective to level a load. Clarke et al. do not suggest which information should be obtained and considered to determine the optimum scale of the redox flow battery when the battery is combined to a power generator that is irregular and unsettled, such as a wind power generator.

Oga et al. do not cure the deficiencies of Erdman. Oga et al. is related to a technique of principally determining an instant capacity of a NaS battery on the basis of only a standard deviation of wind power generation variables without considering the combination of the NaS battery with the wind power generation or selecting a pattern of smoothened target output (output of wind power generation + output of NaS battery). Oga et al. teach that fluctuation of the generated output of the wind power generating equipment can be compensated, regardless of a change of wind speed. Because the invention of Oga et al, employs wind power that is irregular and unsettled as a power source, total output through a year of wind power generator is statistically observed and a variations from the average output value is obtained. On the basis of this variation, the capability of the NaS battery is determined. Furthermore, the NaS battery having a capability to generate substantially equal output to the variation obtained in that way is

combined with the wind power generating equipment. Thus, Oga et al. determine the capability of the NaS battery on the basis of the variation in output of wind power generator, which is statistically calculated.

On the other hand, in the present invention, the optimum scale of the redox flow battery combined to the power generator is not determined based on the variation in the statistically calculated output of wind power generator, but rather is determined from a variation in the statistically calculated required output of the redox flow battery itself.

Differences between Oga et al. and the present invention are explained with the specific examples below.

Fig. A (Case applied to D3, D4)

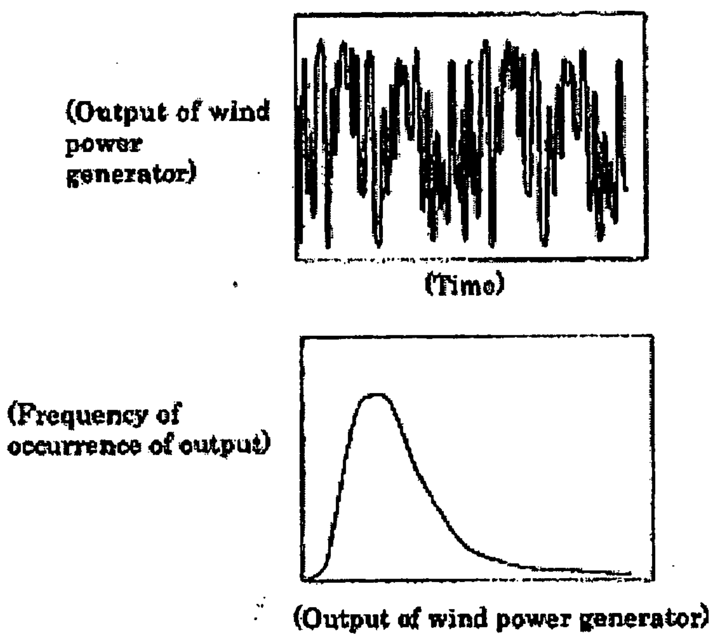
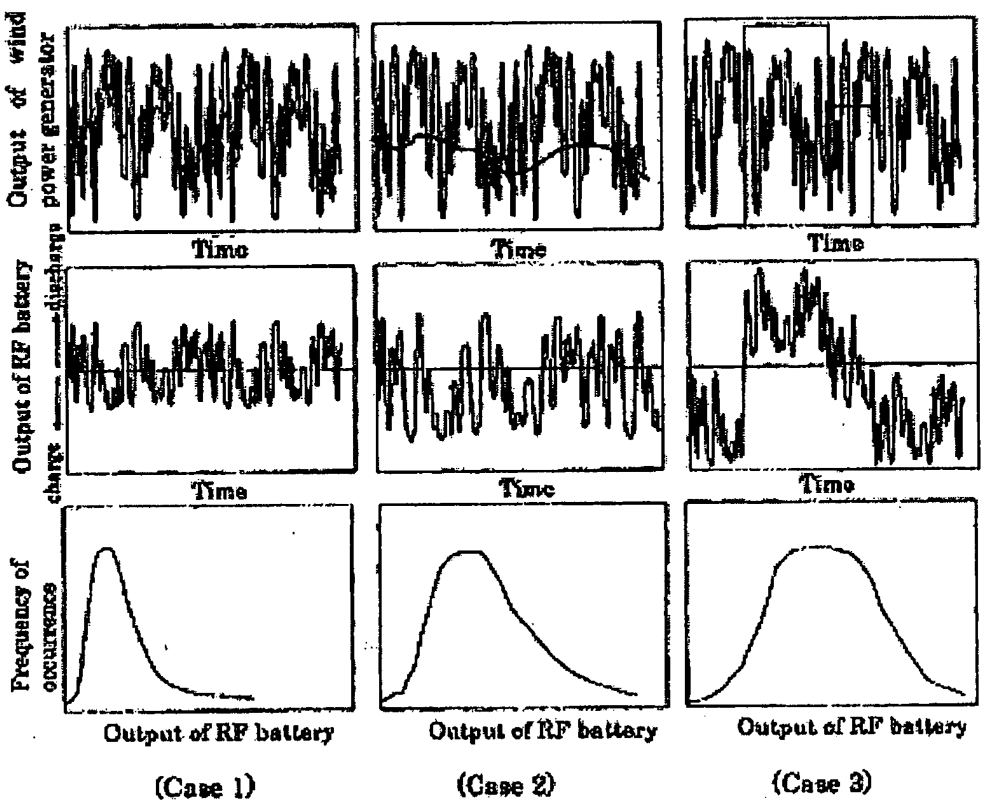


Fig. A shows an example of the output of the wind power generator and frequency of occurrence of output of the wind power generator. When the technique of Oga et al. is used, the standard deviation is obtained from the characteristics of the frequency of occurrence of output, and then, the output of NaS battery is determined based on this single factor. See Oga et al., paragraph 0014 and Fig. 3.

Fig. B below shows the technique of the present invention. The examples of output of wind power generator are the same as Fig. A above.

Fig. B (Explanation drawing related to the present invention)



Case 1 and Case 3 illustrate when the redox flow batteries work for stabilizing or smooth the output of the battery system when the redox flow battery is combined to the wind power

generator. Reference curves shown in the first row in the images show the output of the battery system to be achieved when smoothing the output (total output of the wind power generator plus redox flow battery).

In Case 1, the output of the battery system is smoothened over a short period (intended use of the redox flow battery: smoothing output),

in Case 2, the output of the battery system is smoothened over a long period (intended use of the redox flow battery: smoothing output); and

in Case 3, the total output of wind power generator plus redox flow battery is generated as a predetermined pattern (intended use of the redox flow battery: equalizing of load). In case 3, the redox flow battery absorbs the total output of the wind power generator in the nighttime while generating output in the daytime so as to make the total output of the wind power generator plus the redox flow battery the desired pattern.

Images in the second row show the required output discharged from the redox flow battery (= desired output (reference curve) – actual output of wind power generator).

Images in the third row show the frequencies of occurrence of the output of the redox flow battery.

As clearly illustrated in these Figures, the required output is different in each case when the intended use of the redox flow battery is different. In Fig. B, a greater magnitude of output is required in the order: Case 1 → Case 2 → Case 3. Similarly, variations in output swing in a wider range in the order: Case 1 → Case 2 → Case 3. That is, if the wind power generator is combined to the redox flow battery, the optimum scale of the redox flow battery is changed by its practical use. In other words, the method of Oga et al. is unable to design the optimum scale of the redox flow battery because only a single factor (output of wind power generator) is

considered to determine the scale or the magnitude of output of the NaS battery. To the contrary, in the present invention, the redox flow battery is designed based not on the variation in wind power generator output, but the variation in the required output of the redox flow battery. Therefore, the present invention allows the optimum scale of the redox flow battery suitable for the specific practical use to be designed.

In both Case 1 and Case 2, output of wind power generator with the same output distribution is smoothened, however, the two cases are different in their target output patterns. Case 1 aims to smooth output of wind power generator in a shorter period while Case 2 aims to smooth output of wind power generator in a longer period. Hence, it can be understood from Fig. B that the required output variable range of the redox flow battery is changed by the target output pattern, even in the same wind power generator, and the optimum magnitude of the redox flow battery is changed accordingly.

As noted in the following paragraph, the target output patterns can be arbitrarily selected in the present invention (page 10, lines 8-22 of the present specification):

> The ph[r]ase of "smoothing the output of power generation" used herein is intended to mean that when an output of power generation exceeds a threshold as is preset for the output of power generation, the surplus output exceeding the threshold is charged in the battery, while on the other hand, when an output of power generation is less than the threshold, the output corresponding to the shortage is discharged from the battery. Also, the ph[r]ase of "smoothing the power consumption" used herein is intended to mean that when power consumption exceeds a threshold as is also preset for the power consumption, the output corresponding to the shortage caused by the power consumption exceeding the threshold is discharged from the battery, while on the other hand, when power consumption is less than the threshold, the surplus output is charged in the battery. The same or different thresholds may be used for charging and discharging the battery. Also, the thresholds may be varied depending on the time required for the power generation and the output situation thereof.

It is especially clear that the target output pattern can be selected at the user's option from the description, "the thresholds may be varied depending on the time required for the power generation and the output situation thereof."

As explained above, according to Oga et al., a designer cannot select how to stabilize or smoothen the variation in output of the wind power generator by the NaS battery. The designer is merely able to design a NaS battery based on a single factor, that is, the variation in output of the wind power generator. In short, the "output of NaS battery" corresponds to the "variation in the output of the wind power generator" only. Accordingly, a NaS battery suitable for practical use cannot be designed.

On the other hand, the method of the present invention can design the redox flow battery with an optimum scale suitable for the practical use, (smoothing output, equalization of load, countermeasure to voltage sag, etc.) when combined with a wind power generator or the like to stabilize or smoothen the output of wind power generator. Therefore, the method of the present invention is superior in capability for use in a wide-range of applications. Thus, the method of the present invention is completely different from Oga et al. and achieves superior results.

Oga et al. teach (paragraph [0014] and Fig. 3:

(1) Determining an average value and a standard deviation of wind speed from wind speed distribution.

(2) Determining output L of wind power generator corresponding to the wind speed of [the average value + the standard deviation].

(3) Determining output H of wind power generator corresponding to the wind speed of [the average value + double the standard deviation].

(4) Determining output A of wind power generator corresponding to the wind speed of [the average value].

(5) Adopt a NaS battery which has the instant capacity of [output L · output A] ~ [output H · output A].

(6) Select the discharge duration of the battery to 4 to 8 hours, which correspond to the average change cycle of weather.

According to Oga et al., the instant capacity of the NaS battery is principally determined on the basis of only the standard deviation of wind power generation variables. Oga et al. do not consider combining the NaS battery with the wind power generator and selecting a pattern of smoothened target output (output of wind power generator + output of Na S battery). That is, Oga et al. do not suggest a means of determining an optimum magnitude of the rechargeable battery (the redox flow battery in the present application) in accordance with the pattern of the smoothened target output.

As explained above, there are clear differences between the present invention and the cited references. Additionally, the present invention achieves remarkable working results, which cannot be achieved in the cited references. Therefore, the present invention is clearly unobvious in view of the of the combination of the cited references.

In contrast to the teachings of the cited references, the present invention is related to the method of designing the redox flow battery system to determine the optimum magnitude of the redox flow battery which is to be combined with the wind power generator or the like. What the present method determines is not the smoothened target output (output of wind power generator + output of redox flow battery) or the power generated from existing redox flow battery system,

but the specified output of the redox flow battery as a technical specification, that is, rated output.

Obviousness can be established by combining or modifying the teachings of the prior art to produce the claimed invention where there is some teaching, suggestion, or motivation to do so found either explicitly or implicitly in the references themselves or in the knowledge readily available to one of ordinary skill in the art. *In re Kahn*, 441 F.3d 977, 986, 78 USPQ2d 1329, 1335 (Fed. Cir. 2006); *In re Kotzab*, 217 F.3d 1365, 1370 55 USPQ2d 1313, 1317 (Fed. Cir. 2000); *In re Fine*, 837 F.2d 1071, 5 USPQ2d 1596 (Fed. Cir. 1988); *In re Jones*, 958 F.2d 347, 21 USPQ2d 1941 (Fed. Cir. 1992). There is no suggestion in Erdman, Clarke et al., or Oga et al. to modify the method of Erdman to include the steps of determining a difference between an output of power generation of generating equipment that varies irregularly in output of power generation, and a desired target output obtained by smoothing the output of power generation, determining an average value and a standard deviation of a distribution of the output difference, and determining at least one of a specified output of the redox flow battery, the number of batteries, specified output of the DC/AC converter for converting the battery output, and number of the DC/AC converters for converting the battery output, to maximize a system efficiency of the system or to minimize a loss rate of the system, based on the average value and the standard deviation, as required by claim 3, nor does common sense dictate such a modification. The Examiner has not provided any evidence that there would be any obvious benefit in making such a modification of Erdman et al. *See KSR Int'l Co. v. Teleflex, Inc.*, 500 U.S. ____ (No. 04-1350, April 30, 2007) at 20.

The only teaching of the claimed method of designing a redox flow battery is found in Applicants' disclosure. However, the teaching or suggestion to make a claimed combination and

the reasonable expectation of success must and not be based on applicant's disclosure. *In re Vaeck*, 947 F.2d 488, 20 USPQ2d 1438 (Fed. Cir. 1991).

The dependent claims are allowable for at least the same reasons as claim 3 and further distinguish the claimed method.

In view of the above amendment and remarks, Applicants submit that this case should be allowed and passed to issue. If there are any questions regarding this Amendment or the application in general, a telephone call to the undersigned would be appreciated to expedite the prosecution of the application.

To the extent necessary, a petition for an extension of time under 37 C.F.R. § 1.136 is hereby made. Please charge any shortage in fees due in connection with the filing of this paper, including extension of time fees, to Deposit Account 500417 and please credit any excess fees to such deposit account.

Respectfully submitted,

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